JC09 Rec'd PCT/PTO 04 MAY 2001
09/831225

1512-37

**Practitioner's Docket No.** _____

**CHAPTER II**

Preliminary Classification:

Proposed Class:

Subclass:

NOTE: *"All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.'" M.P.E.P., § 601, 7th ed.*

# TRANSMITTAL LETTER TO THE UNITED STATES ELECTED OFFICE (EO/US)

## (ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)

| INTERNATIONAL APPLICATION NO. | INTERNATIONAL FILING DATE | PRIORITY DATE CLAIMED |
|---|---|---|
| PCT/FR99/02767 | 10 Nov. 1999 | 10 Nov. 1998 |

TITLE OF INVENTION
ELECTROSTATIC MAINTAINING DEVICE

APPLICANT(S)
PELLEGRIN,Yvon; HERNANDEZ,Jose; CLAUDE,Richard; HALE,William

**Box PCT**
**Assistant Commissioner for Patents**
**Washington D.C. 20231**

**ATTENTION: EO/US**

**CERTIFICATION UNDER 37 C.F.R. § 1.10***

*(Express Mail label number is **mandatory**.)*
*(Express Mail certification is optional.)*

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date May 4, 2001, in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL801595965US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

John S. Egbert

*(type or print name of person mailing paper)*

Signature of person mailing paper

***WARNING:*** *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

*NOTE: To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and (2) the basic national fee (see 37 C.F.R. § 1.492(a)). The 30-month time limit may not be extended. 37 C.F.R. § 1.495.*

***WARNING:** Where the items are those which can be submitted to complete the entry of the international application into the national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. § 1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing—See 37 C.F.R. § 1.8.*

*NOTE: Documents and fees must be clearly identified as a submission to enter the national state under 35 U.S.C. § 371 otherwise the submission will be considered as being made under 35 U.S.C. § 111. 37 C.F.R. § 1.494(f).*

I. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. § 371:

a. ☒ This express request to immediately begin national examination procedures (35 U.S.C. § 371(f)).

b. ☒ The U.S. National Fee (35 U.S.C. § 371(c)(1)) and other fees (37 C.F.R. § 1.492) as indicated below:

2. Fees

| CLAIMS FEE | (1) FOR | (2) NUMBER FILED | (3) NUMBER EXTRA | (4) RATE | (5) CALCULATIONS |
|---|---|---|---|---|---|
| ☐* | TOTAL CLAIMS | 9 −20= | | × $18.00= | $ |
| | INDEPENDENT CLAIMS | 1 −3= | | × $80.00= | |
| | MULTIPLE DEPENDENT CLAIM(S) (if applicable) | | | + $270.00 | |
| BASIC FEE** | ☐ U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY<br>Where an International preliminary examination fee as set forth in § 1.482 has been paid on the international application to the U.S. PTO:<br>☐ and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(1) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 C.F.R. § 1.492(a)(4)) ..... $100.00<br>☐ and the above requirements are not met (37 C.F.R. § 1.492(a)(1)) ..... $690.00<br>☒ U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY<br>Where no international preliminary examination fee as set forth in § 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in § 1.445(a)(2) to the U.S. PTO:<br>☐ has been paid (37 C.F.R. § 1.492(a)(2)) ..... $710.00<br>☐ has not been paid (37 C.F.R. § 1.492(a)(3)) ..... $1000.00<br>☒ where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 C.F.R. § 1.492(a)(5) ) ..... $860.00 | | | | 860 |
| | Total of above Calculations | | | | = 860 |
| SMALL ENTITY | Reduction by 1/2 for filing by small entity, if applicable. Affidavit must be filed also. (note 37 C.F.R. § 1.9, 1.27, 1.28) | | | | − 430 |
| | Subtotal | | | | 430 |
| | Total National Fee | | | | $ 430 |
| | Fee for recording the enclosed assignment document $40.00 (37 C.F.R. § 1.21(h)). (See Item 13 below). See attached "ASSIGNMENT COVER SHEET". | | | | |
| TOTAL | Total Fees enclosed | | | | $ 430 |

*See attached Preliminary Amendment Reducing the Number of Claims.

☐ Attached is a ☐ check ☐ money order in the amount of $ _____

☒ Authorization is hereby made to charge the amount of $ 430

☐ to Deposit Account No. _____

☒ to Credit card as shown on the attached credit card information authorization form PTO-2038.

***WARNING:** Credit card information should not be included on this form as it may become public.*

☒ Charge any additional fees required by this paper or credit any overpayment in the manner authorized above.

A duplicate of this paper is attached.

***"WARNING:** "To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: * * * (2) the basic national fee (see § 1.492(a)). The 30-month time limit may not be extended." 37 C.F.R. § 1.495(b).*

***WARNING:** If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. § 1.495(b)(2). The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 apply to the period which is set. Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.*

3. ☒ A copy of the International application as filed (35 U.S.C. § 371(c)(2)):

*NOTE: Section 1.495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.*

a. ☒ is transmitted herewith.

b. ☐ is not required, as the application was filed with the United States Receiving Office.

c. ☐ has been transmitted

i. ☐ by the International Bureau.
Date of mailing of the application (from form PCT/1B/308):
_____

ii. ☐ by applicant on _____. *(Date)*

4. ☒ A translation of the International application into the English language (35 U.S.C. § 371(c)(2)):

a. ☒ is transmitted herewith.

b. ☐ is not required as the application was filed in English.

c. ☐ was previously transmitted by applicant on _____. *(Date)*

d. ☐ will follow.

5. ☐ Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. § 371(c)(3)):

*NOTE: The Notice of January 7, 1993 points out that 37 C.F.R. § 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that: "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under section 1.121. In many cases, filing an amendment under section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.*

a. ☐ are transmitted herewith.

b. ☐ have been transmitted

i. ☐ by the International Bureau.
Date of mailing of the amendment (from form PCT/1B/308):

_____.

ii. ☐ by applicant on _____. *(Date)*

c. ☐ have not been transmitted as

i. ☐ applicant chose not to make amendments under PCT Article 19.
Date of mailing of Search Report (from form PCT/ISA/210.):

_____.

ii. ☐ the time limit for the submission of amendments has not yet expired. The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. ☐ A translation of the amendments to the claims under PCT Article 19 (38 U.S.C. § 371(c)(3)):

a. ☐ is transmitted herewith.

b. ☐ is not required as the amendments were made in the English language.

c. ☐ has not been transmitted for reasons indicated at point 5(c) above.

7. ☒ A copy of the international examination report (PCT/IPEA/409)

☒ is transmitted herewith.

☐ is not required as the application was filed with the United States Receiving Office.

8. ☐ Annex(es) to the international preliminary examination report

a. ☐ is/are transmitted herewith.

b. ☐ is/are not required as the application was filed with the United States Receiving Office.

9. ☐ A translation of the annexes to the international preliminary examination report

a. ☐ is transmitted herewith.

b. ☐ is not required as the annexes are in the English language.

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10. ☒ An oath or declaration of the inventor (35 U.S.C. § 371(c)(4)) complying with 35 U.S.C. § 115

a. ☐ was previously submitted by applicant on _____
Date

b. ☐ is submitted herewith, and such oath or declaration

i. ☐ is attached to the application.

ii. ☐ identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and states that they were reviewed by the inventor as required by 37 C.F.R. § 1.70.

c. ☒ will follow.

II. Other document(s) or information included:

11. ☒ An International Search Report (PCT/ISA/210) or Declaration under PCT Article 17(2)(a):

a. ☒ is transmitted herewith.

b. ☐ has been transmitted by the International Bureau.
Date of mailing (from form PCT/IB/308): _____

c. ☐ is not required, as the application was searched by the United States International Searching Authority.

d. ☐ will be transmitted promptly upon request.

e. ☐ has been submitted by applicant on _____
Date

12. ☐ An Information Disclosure Statement under 37 C.F.R. §§ 1.97 and 1.98:

a. ☐ is transmitted herewith.

Also transmitted herewith is/are:

☐ Form PTO-1449 (PTO/SB/08A and 08B).

☐ Copies of citations listed.

b. ☐ will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. § 371(c).

c. ☐ was previously submitted by applicant on _____
Date

13. ☒ An assignment document is transmitted herewith for recording.

A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

SEMCO Engineering S.A.

x will follow.

14. ☒ Additional documents:
    a. ☐ Copy of request (PCT/RO/101)
    b. ☒ International Publication No. WO 00/28654
        i. ☐ Specification, claims and drawing
        ii. ☒ Front page only
    c. ☒ Preliminary amendment (37 C.F.R. § 1.121)
    d. ☐ Other

15. ☒ The above checked items are being transmitted
    a. ☒ before 30 months from any claimed priority date.
    b. ☐ after 30 months.

16. ☐ Certain requirements under 35 U.S.C. § 371 were previously submitted by the applicant on _____, namely:

## AUTHORIZATION TO CHARGE ADDITIONAL FEES

***WARNING:*** *Accurately count claims, especially multiple dependant claims, to avoid unexpected high charges if extra claims are authorized.*

*NOTE: "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).*

*NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).*

☒ Please charge, in the manner authorized above, the following additional fees that may be required by this paper and during the entire pendency of this application:

☒ 37 C.F.R. § 1.492(a)(1), (2), (3), and (4) (filing fees) but not for multiple dependent claims

***WARNING:*** *Because failure to pay the national fee within 30 months without extension (37 C.F.R. § 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.*

☐ 37 C.F.R. § 1.492(b), (c) and (d) (presentation of extra claims)

*NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.*

☐ 37 C.F.R. § 1.17 (application processing fees)

☐ 37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

*NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).*

*NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.*

☐ 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).

**SIGNATURE OF PRACTITIONER**

Reg. No.: 30,627

John S. Egbert

*(type or print name of practitioner)*

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412 Main St., 7th Floor

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Houston, Texas 77002

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: PELLEGRIN,Yvon; HERNANDEZ,Jose; CLAUDE,Richard; HALE,William

SERIAL NO.: (Intl. App. No. PCT/FR99/02767)

FILED: (Intl. File Date: November 10, 1999)

TITLE: ELECTROSTATIC MAINTAINING DEVICE

PRELIMINARY AMENDMENT

Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

In conjunction with the filing of the present application, and prior to an initial Official Action on this matter, please amend the above-identified application as follows:

Please note that the following amendments apply to the English translation of the application. There was no annex to the International Preliminary Examination Report.

IN THE TITLE

On page 1, line 1, delete "holding" and insert therefor --Maintaining--.

IN THE SPECIFICATION

On page 1, line 6, delete "The invention presented here" insert

--BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention--.

On page 1, line 6, delete "holding" and insert therefor --maintaining--.

On page 1, line 9, delete "vacuum, for example." and insert therefor --vacuum.--.

On page 1, line 10, before "The different treatment" insert

-- 2. Description of Related Art--.

On page 1, line 15, delete "can not" and insert therefor --cannot--.

On page 2, line 5, delete "The US" and insert therefor --U.S.--.

On page 2, line 17, delete "The patent" and insert therefor --European patent--.

On page 3, line 6, delete "thus".

On page 3, line 8, before "The purpose of" insert

--BRIEF SUMMARY OF THE INVENTION--.

On page 3, line 9, delete "thus".

On page 3, line 10, delete "in".

On page 4, line 1, before "Other advantage" insert

--BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS--.

On page 4, line 3, delete "drawings, in which:" and insert therefor --drawings.--.

On page 4, line 5, delete "the diagram of".

On page 4, line 6, delete "device." and insert therefor --device of the present invention.--.

On page 4, line 7, delete "shows" and insert therefor --shows a top view of--.

On page 4, line 8, delete "a variation" and insert therefor --a top view of an--.

On page 4, line 9, delete "shows other possible" and insert therefor --show top views of other embodiment with different--.

On page 4, line 11, before "As can be seen" insert

--DETAILED DESCRIPTION OF THE INVENTION--.

On page 5, line 14, delete ", for example,".

On page 6, line 14, delete "consists in" and insert therefor --consists of--.

On page 6, line 18, delete ", for example,".

IN THE CLAIMS

On page 10, line 1, delete "Claims" and insert therefor

--CLAIMS

We claim:--.

In Claim 1, line 1, delete "holding" and insert therefor --maintaining--.

In Claim 1, line 2, delete "comprised" and insert therefor --comprising--.

In Claim 1, line 2, delete "of". (first and second occurrences).

In Claim 1, line 3, delete "the two" and insert therefor --the--.

In Claim 1, line 5, delete "these" and insert therefor --wherein the--.

In Claim 1, line 6, delete " characterized in that " and insert therefor --wherein--.

In Claim 2, line 1, delete " characterized in that the" and insert therefor --wherein said--.

In Claim 3, line 1, delete "or claim 2, characterized in that the" and insert therefor --, wherein--.

In Claim 4, line 1, delete "any one of the previous claims, characterized in that the" and insert therefor --Claim 1, wherein--.

In Claim 5, line 1, delete "one of the previous claims, characterized in that the" and insert therefor --Claim 1, wherein a--.

In Claim 5, lines 2-3, delete "(bumps or contact terminals, for example)".

In Claim 6, line 1, delete "one of the previous claims, characterized in that the" and insert therefor --Claim 1, wherein said--.

In Claim 7, line 1, delete "one of the previous claims, characterized in that" and insert therefor --Claim 1, wherein--.

In Claim 7, line 2, delete "can be the following:" and insert therefor --comprises--.

In Claim 7, line 17, delete "the cycle" and insert therefor --wherein said cycle--.

In Claim 8, line 1, delete "one of the previous claims, characterized in that" and insert therefor --Claim 1, wherein--.

In Claim 9, line 1, delete "one of the previous claims, characterized in that the" and insert therefor --Claim 1, wherein a--.

Please delete any multiple dependent claims not previously accounted for.

IN THE ABSTRACT

Please insert the following ABSTRACT on a separate page after the CLAIMS. The Abstract is attached on a separate page.

REMARKS

The present Preliminary Amendment has been entered for the purpose of placing the application into a more proper U.S. format. In particular, certain grammatical and idiomatic inconsistencies have been corrected by amendment to the specification, and the application is corrected for certain typographical errors found in the originally submitted application. No new matter has been added by these amendments.

The claims have been amended so as to remove multiple dependent claims and so as to conform with U.S. requirements.

An Abstract has been added so as to conform with U.S. requirements.

Applicant respectfully requests that the present Amendment be entered prior to an initial Official Action on the present application.

Respectfully submitted,

5-3-01

Date

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4/PRTS

# Electrostatic holding device

The invention presented here involves an electrostatic holding device specifically designed to hold wafers of conductor or semiconductor materials such as silicon while they undergo micro-manufacturing or any other type of treatment such as plasma treatment in an enclosure under vacuum, for example.

The different treatment operations all throughout the manufacturing process make it necessary to hold the wafer of material solidly on a support. The wafers are generally moved from one station to another by automated mechanisms.

It is known to hold the wafer by flanges supported on the periphery of the upper surface of the wafer, but these systems have the disadvantage of monopolizing a part of the wafer that can not be treated and will thus be lost.

Also known are electrostatic holding systems that use the principle of placing the wafer of semiconductor material on an insulating surface and arranging two electrodes on this surface. The two electrodes are subjected to a difference in potential. The electric field created by these two electrodes thus generates a phenomenon called "electrostatic adhesion".

The treatments or micro manufacturing performed on the wafer make necessary a very large amount of precision, and the wafer must thus be held perfectly throughout the treatment cycle. However, when the semiconductor material that comprises the wafer or

the material that comprises the sole plate is subjected to an electric field of the same polarity for a certain amount of time, it has a tendency to accumulate charges which will keep the wafer adhered to the same surface when the outside electric field is no longer applied.

The US patent 5452177 describes an electrostatic holding device on a circular insulating surface under which are placed at least six electrodes arranged regularly in pairs, opposite each other relative to the center of the circular surface. The electrodes are supplied by an A.C. voltage generator, supplying six different voltages, each pair of electrodes being supplied cyclically at different polarities. The three pairs of electrodes are supplied by signals that are phase-shifted by a phase of 120 degrees in a manner so that two pairs of electrodes are supplied at the moment when the third changes polarity. The commutation frequencies are on the order of 30 Hz.

In order to achieve this result, the system implements mechanisms for supplying the electrodes which are very complex and thus costly, and on the other hand, the use of A.C. voltages induces currents in the wafer that can be harmful when the wafer is equipped with electronic components.

The patent EP 294 556 describes an electrostatic holding system comprised of two electrodes supplied by a D.C. voltage. Between each cycle for holding the object, the electrode polarities are inverted in order to release electrostatic charges. The configuration of the electrodes described in this patent (in the form of alternating lines) is not suitable for optimizing the distribution of the fields in the object. Thus, the pressure of electrostatic adhesion runs the risk of not being uniform over the entire surface of the object. On the other hand, this patent is limited to the presence of two electrodes. It is

thus not possible to invert the polarity during the treatment of the wafer because it would become unstuck at the moment the polarity is inverted. Finally, if the duration of the holding of the object is relatively sizeable, the accumulated electrostatic charges will make it difficult to detach it.

The main problems encountered in electrostatic adhesion lie in successfully simultaneously obtaining a strong adhesion of the object and easily detaching it, and thus in preventing any accumulation of charges while it is held.

The purpose of the invention presented here is to propose a new electrostatic holding device having a simplified constitution that is thus of economic interest, while ensuring a perfect holding of the wafers and in avoiding any accumulation of charges that can restrict the withdrawal of the wafer.

For this purpose, the device is comprised of an electrically insulating surface under which at least two pairs of electrodes are arranged, characterized in that the pairs of electrodes are supplied cyclically at different polarities in a manner so that at any time at least one pair of electrodes holds the wafer.

Another characteristic of the invention lies in the annular shape of the electrodes. Thus, the pressure for holding the wafer is constant over all of its periphery. Due to this fact, the wafer is held at any moment on its periphery, there is no risk of deformation of the wafer when it is subject to a stress at an isolated point on its surface.

According to another characteristic of the invention, the surface of the holding device has geometric variations that make it possible to limit the contact surface between the wafer and the device.

Other advantages and characteristics appear in reading the following description of the embodiment forms of the invention given as a non-restrictive example and shown by the attached drawings in which:

- Figure 1 shows in a section view and in an overhead view, the diagram of the holding device.
- Figure 2A shows another embodiment form of the holding device with four electrodes and Figure 2B shows a variation with eight electrodes.
- Figure 3A and 3B shows other possible configurations of the electrodes.

As can be seen in Figure 1, the holding device is comprised of a soleplate (1) made of electrically insulating material on which the wafer to be held (2) rests in contact with the surface (3). The electrodes (4) and (5) are arranged under this surface (3). According to a particular embodiment mode, the soleplate (1) is comprised of a base plate (22) on which the electrodes (4) and (5) are arranged, then the assembly is covered by a dielectric layer (23). The electrodes (4) and (5) and the dielectric layer (23) can be made by serigraphy of thick films according to techniques known to the professional. The use of the technique of serigraphy of thick films in the case of the dielectric layer (23) makes it possible to easily create geometric variations on the surface of the contact with the wafer. These geometric variations, made up of bumps or contact terminals, for example, make it possible to limit the surface of contact between the wafer and the adhesion device. Thus, it is possible to obtain the optimum surface necessary to hold the wafer well. In fact, when the surface of the contact is very weak, the holding force is not

sufficient and when the contact surface is very sizeable, it becomes difficult to rapidly detach the wafer.

The base plate (22) can be made of any type of dielectric material, i.e. it is electrically insulating. According to one particular embodiment mode of the invention, the base plate (22) will be made of virgin alumina. The base plate (22) can also be made of titanium or molybdenum. The dielectric layer (23) covering the electrodes can also be made of any type of dielectric material having a ceramic base, for example.

The wafer (2) is arranged flat on the surface (3). According to an embodiment mode of the invention, the electrodes (4) and (5) have an annular shape and are arranged on the surface (3) in parallel to the wafer. In this configuration, the electrodes have concentric rings of different diameters whose center corresponds to the center of the soleplate (1). The annular shape of the electrodes is preferred since the soleplate (3) is generally of a circular shape, which makes it possible to hold it over its entire periphery. However, in order to hold the rectangular pieces, for example, the electrodes could be devices in the corresponding shape. The wafer (2) must be arranged on the surface (3) in a manner so that its center corresponds to the center of the rings of the electrodes. In order to obtain a good distribution of the electric field, the planar surfaces of the rings forming the electrodes have the same area. The central electrode (5) can be made in the form of a ring and a disc. The electrodes (4) and (5) are subject to a voltage difference by the intermediary of the power supply (6) that supplies a D.C. voltage of 1000 volts, for example. The field lines created between the wafer and the two electrodes allow the electrostatic adhesion of the wafer (2) on the surface (3). The adhesion pressure is proportional to the square of the voltage difference between the two electrodes.

When they are subjected to an intense electric field, the materials that constitute the soleplate (1) and the wafer (2) have a tendency to accumulate electrostatic charges which runs the risk of disturbing the detachment of the wafer even when the electrodes are no longer supplied with power. This accumulation of electrostatic charges is proportional to the time in which the device is supplied as well as the value of the voltage.

The wafer resting on the surface (3) is generally raised by rods (20) distributed on its surface in order to then be grasped by a manipulator arm. The rods translate vertically in holes (21) that go through the soleplate (1) under the action of an actuator, for example. One thus imagines very well that the rods would damage the wafer if the wafer stayed adhered to the surface (3).

In the case of a device that consists of two electrodes and for the processes that require a relatively short holding time, for which the wafer (2) does not have the time to become charged, the solution consists in inverting the polarities of the two electrodes between each change of the wafer. Thus, the charges accumulated by the soleplate (1) can drain off. For this purpose, the power supply is provided with a known type of automatic system for changing the polarity, for example, synchronized with the manufacturing or treatment cycle, at each end of the cycle, for example, the polarities are inverted.

For treatment times that are longer or require a greater adhesion pressure, the present invention proposes using several pairs of electrodes supplied cyclically at different polarities in a manner so that at any moment at least one pair of electrodes holds the piece. According to a possible embodiment mode of the invention presented in

Figure 2A, the electrodes are made in the form of four concentric rings (7), (8), (9), and (10) functioning in pairs. The power supply is provided for this purpose with a system for polarization and supplying power to the electrodes cyclically. The cycle of power supply and polarization of the electrodes can be the following, for example.

From t0 to t1, the electrode (7) is supplied positively and the electrode (9) is supplied negatively.

From t1 to t2, the electrode (7) is supplied positively, the electrode (9) is supplied negatively and the electrode (8) is supplied positively and the electrode (10) is supplied negatively.

At t2, the electrodes (7) and (9) no longer need to be supplied with power since the electrodes (8) and (10) have taken over the relay.

From t2 to t3, the electrode (8) is supplied positively, and the electrode (10) is supplied negatively.

From t3 to t4, the electrode (8) is supplied positively, the electrode (10) is supplied negatively and the electrodes (7) and (9) are re-supplied, but at different polarities which allows the charges to drain off.

From t4 to t5, the electrode (7) is supplied negatively, and the electrode (9) is supplied positively.

The cycle thus continues during the entire treatment or manufacturing phase of the wafer.

The pairs of electrodes designated above are only one example to illustrate the functioning of the device, one could just as well imagine the electrodes (7) and (10) functioning together or any other possible combination.

According to another embodiment mode shown in Figure 2B, each electrode is split in two, i.e. four pairs of electrodes, in a manner so as to obtain a better distribution of the adhesion pressure. The power supply cycle is the same as above.

According to this principle of inversion of polarities, the soleplate can stay held indefinitely without an accumulation of charges. Moreover, since a sizeable value of voltage no longer risks charging the wafer too rapidly, the adhesion pressures can become much more sizeable.

The commutation time of the electrodes can be variable depending on the supply voltage and depending on the capacity of the wafer to charge. As an example, for a wafer made of silicon held at a voltage of 1000 volts, the optimum commutation time is one minute, or a commutation frequency of 0.016 Hz. It is very obvious that this time is variable and can be reduced to a few seconds or less; however, it is important to prevent an excessive commutation that would damage the components of the power supply. In a general manner, the commutation frequency can be between 0.01 Hz and 1 Hz. The components and the embodiment mode of the power supply (6) do not need to be described in detail since they are perfectly known to the professional. As an example, the commutations can be made by relays controlled by a programmable automaton.

The number of rings that form the electrodes is not absolutely limited to four or eight and their number can be even greater without leaving the frame of the present invention.

The configuration of the electrodes can also be done in numerous other forms presented in the Figures 3A and 3B. The symmetry and the equal areas are points common to all of the possible configurations of the electrodes. In Figure 3A, the

electrodes (15) are disk portions numbering four functioning in pairs opposite each other. The number of portions that form the electrodes is variable depending on the stresses in the soleplate and the desired distribution of adhesive pressures, the electrodes can number four as shown in Figure 3A. For greater pressures, the number of pairs of electrodes can be multiplied as shown in Figure 3B.

## Claims

1) Device for electrostatically holding a wafer of conductor or semi-conductor material, comprised of an electrically insulating soleplate (1) on which the wafer (2) is arranged, of at least two pairs of electrodes (7), (8), (9), and (10), where the two electrodes of each pair are subjected to a voltage difference generated by a power supply (6) that supplies a D.C. voltage and thus creates an intense electric field, these electrodes are arranged under the insulating surface, characterized in that the electrode pairs are supplied cyclically at different polarities in a manner so that at any moment at least one electrode pair holds the wafer.

2) Device according to claim 1, characterized in that the electrodes are concentric rings.

3) Device according to claim 1 or claim 2, characterized in that the arrangement of electrodes is symmetrical or concentric relative to the center of the soleplate (1).

4) Device according to any one of the previous claims, characterized in that the planar surfaces of the two electrodes forming one pair have the same area.

5) Device according to one of the previous claims, characterized in that the surface of contact between the wafer and the adhesion device have geometric variations (bumps or contact terminals, for example).

6) Device according to one of the previous claims, characterized in that the electrodes and the dielectric layer (23) are made by serigraphy of thick films on a base plate (22).

7) Device according to one of the previous claims, characterized in that a power supply cycle of the electrodes can be the following:

From t0 to t1, the electrode (7) is supplied positively and the electrode (9) is supplied negatively.

From t1 to t2, the electrode (7) is supplied positively, the electrode (9) is supplied negatively and the electrode (8) is supplied positively and the electrode (10) is supplied negatively.

At t2, the electrodes (7) and (9) no longer need to be supplied with power since the electrodes (8) and (10) have taken over the relay.

From t2 to t3, the electrode (8) is supplied positively, and the electrode (10) is supplied negatively.

From t3 to t4, the electrode (8) is supplied positively, the electrode (10) is supplied negatively and the electrodes (7) and (9) are re-supplied, but at different polarities which allows the charges to drain off.

From t4 to t5, the electrode (7) is supplied negatively, and the electrode (9) is supplied positively.

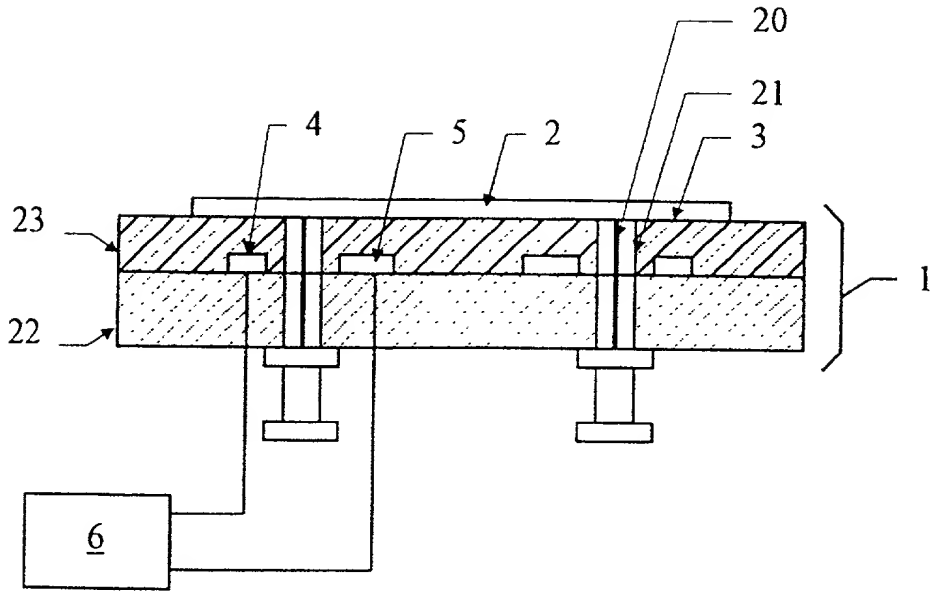
The cycle continues thus during the entire treatment or manufacturing phase of the wafer.

8) Device according to one of the previous claims, characterized in that each electrode (7), (8), (9) and (10) is split in two.

9) Device according to one of the previous claims, characterized in that the frequency of commutation of the electrodes is between 0.01 Hz and 1 Hz.

## ABSTRACT OF THE DISCLOSURE

The invention concerns an electrostatic maintaining device particularly designed for maintaining wafers made of conductor or semiconductor material such as silicon while they are being subjected to micromachining processes or any other type of treatment such as plasma treatment in a vacuum chamber for instance. The device consists of an electrically insulating surface beneath which are arranged at least two electrodes. The electrodes are powered by a direct current whereof the polarities are periodically inverted so as to release the accumulated static charges.



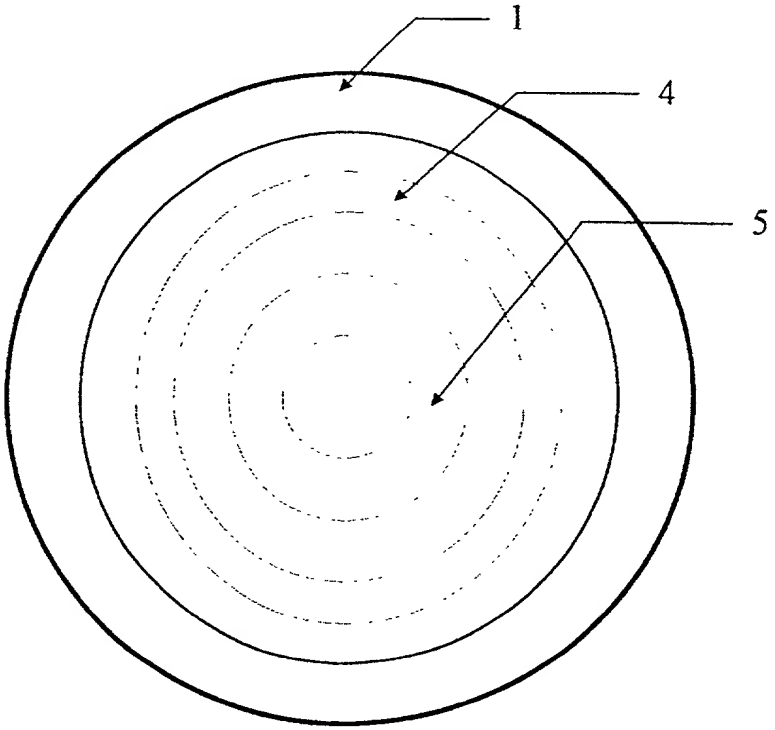




Figure 1

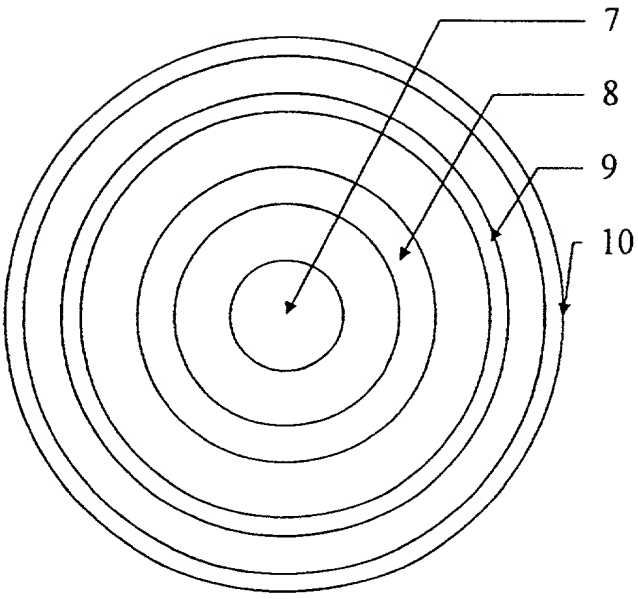



**Figure 2A**

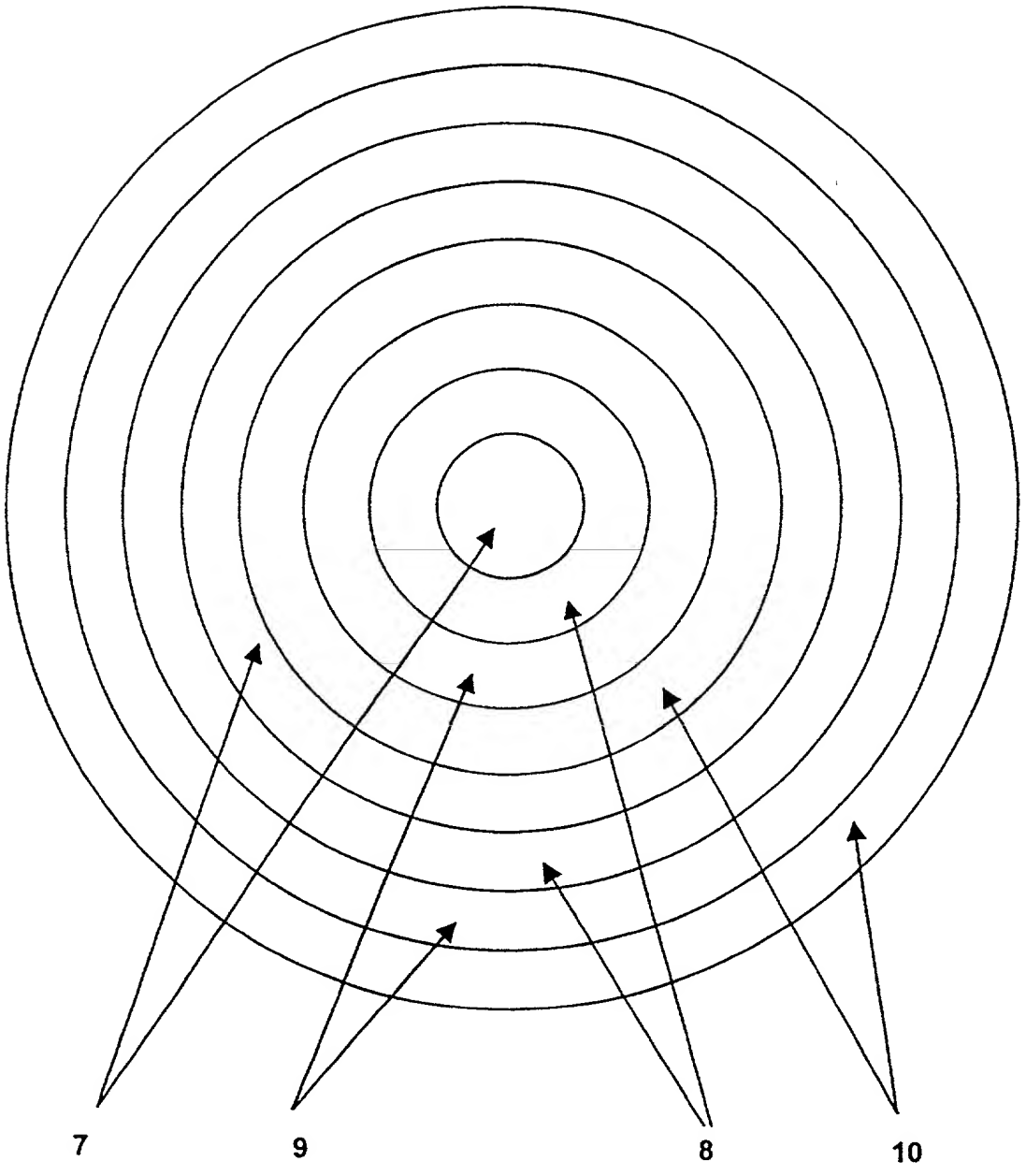



Figure 2B

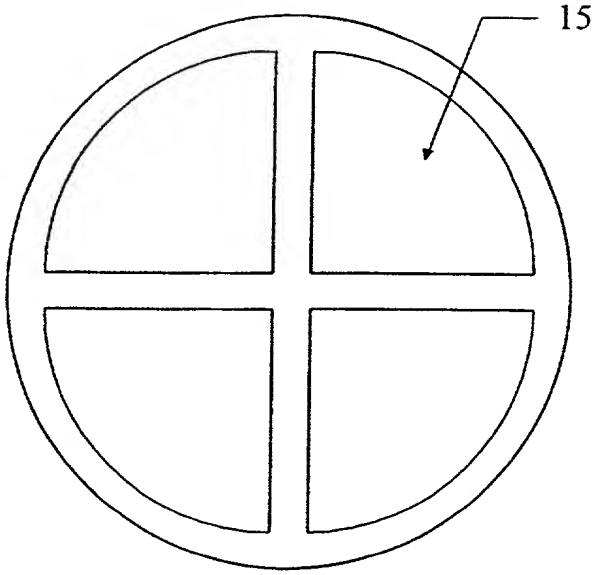



Figure 3A

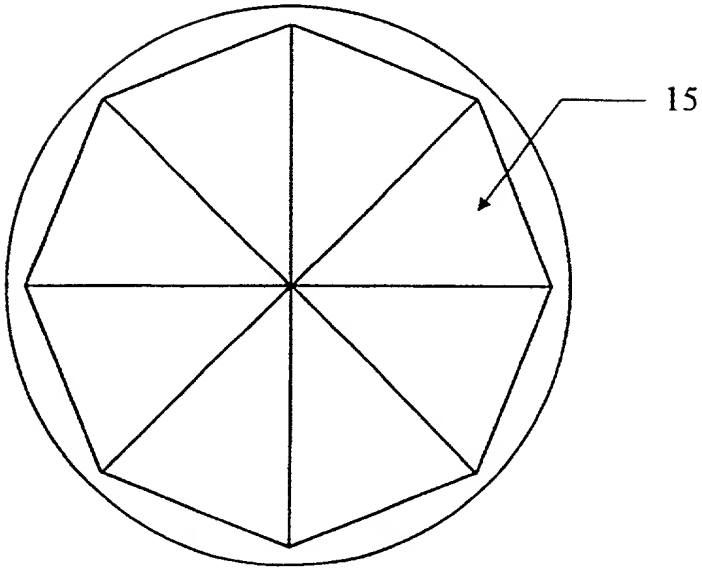



Figure 3B

# Declaration and Power of Attorney for Patent Application

# Déclaration et Pouvoirs pour Demande de Brevet

## French Language Declaration

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que:

As a below named inventor, I hereby declare that:

Mon domicile, mon adresse postale et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

My residence, post office address and citizenship are as stated next to my name.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ELECTROSTATIC MAINTAINING DEVICE

et dont la description est fournie ci-joint à moins que la case suivante n'ait été cochée:

the specification of which is attached hereto unless the following box is checked:

☐ a été déposée le _____ sous le numéro de demande des Etats-Unis ou le numéro de demande international PCT _____ et modifiée le _____ (le cas échéant).

☒ was filed on 10 Nov. 1999 as United States Application Number or PCT International Application Number PCT/FR99/02767 and was amended on _____ (if applicable).

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises, telles que modifiées par toute modification dont il aura été fait référence ci-dessus.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.



Burden Hour Statement: This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 2631.

**French Language Declaration**

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, § 119(a)-(d) ou § 365(b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35 365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet tout certificat d'inventeur ou toute demande internationale PCT ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

I hereby claim foreign priority under Title 35, United States Code, § 119(a)-(d) or § 365 (b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

| Prior foreign application(s)<br>Demande(s) de brevet antérieure(s)<br>(Number)<br>(Numéro) | (Country)<br>(Pays) | (Day/Month/Year Filed)<br>(Jour/Mois/Année de dépôt) | Priority Claimed<br>Droit de priorité revendiqué |
|---|---|---|---|
| 98/14161 | France | 10 Nov. 1998 | ☒ yes, claimed |
| | | | ☐ |

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 119(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

| (Application No.)<br>N° de demande) | (Filing Date)<br>(Date de dépôt) |
|---|---|
| | |
| | |

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulguédans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande:

I hereby claim the benefit under Title 35, United States Code § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

| (Application No.)<br>(N° de demande) | (Filing Date)<br>(Date de dépôt) | (Status) (patented, pending, abandoned)<br>(Statut) (breveté, en cours d'examen, abandonné) |
|---|---|---|
| | | |
| | | |

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridiquc et que toute déclaration formulée á partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de conipromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**French Language Declaration**

POUVOIRS: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu'ils poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques: *(mentionner le nom et le numéro d'enregistrement).*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*
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Customer No. 24106

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(Fournir les mêmes renseignements et la signature de tout co-inventeur supplémentaire.)

(Supply similar information and signature for third and subsequent joint inventors.)

(1 additional page of inventors)

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POUVOIRS: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu'ils poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques: *(mentionner le nom et le numéro d'enregistrement).*

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(Supply similar information and signature for third and subsequent joint inventors.)

(1 of 1 additional page of inventors)